

In the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (Original) A method for overlaying a second layer pattern on a substrate having a first layer pattern, comprising: (a) providing a substrate having a first photoresist layer formed thereon and patterning said first photoresist layer by a patternwise exposure through a first layer mask comprised of an inner pattern area and an outer region, and a plurality of first reference marks formed within the inner pattern area and on the outer region; (b) transferring the first layer pattern into said substrate and removing said first photoresist layer to form a first layer pattern in said substrate wherein the first layer pattern includes first reference marks each having a center point; (c) forming a second photoresist layer on the first layer pattern and patternwise exposing said second photoresist layer through a second layer mask comprised of an inner pattern area, an outer region, and a plurality of second reference marks formed within the inner pattern area and on the outer region wherein each second reference mark is matched with a first reference mark at a similar location on the first layer mask, said second photoresist layer is developed to form a second layer pattern with second reference marks each having a center point; (d) determining the offset values of the center points for each matched pair of first and second reference marks formed in the first layer pattern and in the second layer pattern; (e) inputting the offset values into an error table and applying a correction algorithm to the data in the error table which calculates adjustments in the exposure tool settings for subsequent exposures with the second layer mask of a second photoresist layer on a first layer pattern; and (f) removing the second reference marks in the second layer pattern by exposing said second photoresist layer comprised of the second layer pattern with a third mask having clear regions that are located at the

same locations as the second reference marks in the second layer mask and then developing said second photoresist layer.

2. (Original) The method of claim 1 wherein said first reference marks on the first layer mask and said second reference marks on the second layer mask are clear regions that are surrounded by chrome and the first and second layer masks are binary masks.

3. (Original) The method of claim 1 wherein said first reference marks on the first layer mask and said second reference marks on the second layer mask are comprised of chrome that is surrounded by clear regions and the first layer mask and second layer mask are binary masks.

4. (Original) The method of claim 1 wherein said first reference marks on the first layer mask and said second reference marks on the second layer mask are regions that transmit light which is 180° out of phase with light that is transmitted through adjacent regions and the first layer mask and second layer mask are phase shifting masks.

5. (Original) The method of claim 1 wherein each of said first reference marks on the first layer mask and each of the second reference marks on the second layer mask are comprised of a first pair of parallel lines oriented along an x-axis and a second pair of parallel lines oriented along a y-axis that intersect with said first pair of lines to form a square shape and wherein said lines have a length and a width.

6. (Original) The method of claim 5 wherein a first reference mark on a first layer mask is comprised of lines having a width of about 8 microns and a length of about 80 microns.

7. (Original) The method of claim 5 wherein a second reference mark on a second layer mask is comprised of lines having a width of about 2 microns and a length of about 40 microns.

8. (Original) The method of claim 5 wherein said all of said first reference marks on the first layer mask have the same length and width and wherein all of the second reference marks on the second layer mask have the same length and width.

9. (Original) The method of claim 1 wherein said first photoresist and said second photoresist are positive tone photoresists.

10. (Original) The method of claim 1 wherein a scanning electron microscope with top-down viewing capability (CD-SEM) is used to measure the (x,y) coordinates for the center points of each first reference mark in the first layer pattern and each second reference mark in the second layer pattern.

11. (Original) The method of claim 1 wherein said correction algorithm is used to make adjustments in exposure tool settings in terms of field rotation, magnification, x and y stage scale, orthogonality, and offset translation.

12. (Original) The method of claim 1 wherein a clear region in said third mask is slightly larger than a second reference mark in said second layer mask and said exposure with the third mask does not expose any pattern features in said second photoresist layer.

13. (Original) The method of claim 1 wherein said third mask is a binary mask.

14. (Original) The method of claim 1 wherein the calculations made by said correction algorithm enable a better overlay of the second layer pattern on the first layer pattern in subsequent exposures than a correction algorithm that does not include measurements of reference marks located within an inner pattern area.

15. (Original) The method of claim 1 wherein a second layer pattern is overlaid on a first layer pattern on a plurality of substrates and the first patternwise exposure and second patternwise exposure are performed on multiple exposure tools and wherein steps (a)-(f) are performed for each combination of exposure tool, first layer mask, and second layer mask.

16. (Original) The method of claim 1 wherein the plurality of first reference marks are formed in a "m"x"n" array on the first layer mask and the plurality of second reference marks are formed in a "m"x"n" array on the second layer mask and wherein said error table is comprised of "m" rows and "n" columns.

17-38. (Canceled).